Wheeler and Cutsforth
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SYNAESTHESIA IN JUDGING AND CHOOSING*

From the Psychological Laboratories of the Universities of Kansas and of Oregon

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I

In extending our series of introspective studies of synaesthesia to the realm of the comparative judgment we adopted a simplification of Fernberger's[1] method. Three series of experiments were performed on T. D. C., (*A*) with R. H. W. as the experimenter.[2]

In series 1 we used simple weights of uniform size, constructed from black cardboard, loaded with shot and paraffin as follows: 2 standard weights of 45 grams each, a heavier comparison weight of 50 grams, and a lighter comparison weight of 40 grams. Since it was not our purpose to investigate the just-noticeable difference of kinaesthetic sensation but to obtain introspective data upon the judgments, heavier, lighter, and equal, we chose such stimuli as seemed, in a preliminary series of experiments, to yield uniform results and to insure optimal conditions for detailed analyses. *A* was seated comfortably at an experimenting table with his arm outstretched in a position for lifting the weights. At a given signal from *E* he lowered his hand and grasped the standard weight, lifted it once and replaced it, making rhythmic motions to the beating of a metronome. The observer then lifted his arm again while the experimenter substituted the comparison weight. This was lifted in the same rhythm as the first. *A* then pronounced his judgment and immediately dictated his introspection.

In the second series, the experimenter used a small metal hammer and tapped in certain rhythms upon a sounding board. *A* was to judge whether the second interval of time was equal to, shorter, or longer than the first. One second was used as the standard interval. Comparison intervals consisted of half seconds, seconds, and one and one-half seconds respectively. The experimenter used a tenths-second stop watch in determining the lengths of these intervals. Introspective data were dictated immediately after each judgment.

In the third series a Quincke whistle was used. Here the method was crude but employed for the practical purpose, alone, of pro-

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[1] *Psychol. Monog.*, 1919. For bibliography of previous studies of synaesthesia see *J. Exper. Psychol.*, 1925, 8, 149.

[2] These investigations were carried out under the direction of R. H. Wheeler.

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ducing judgments of sound-intensity, not for the purpose of measuring thresholds. The experimenter produced a tone of moderate intensity followed, after a one-second interval, by another tone appreciably louder or less intense than the first, or a tone which seemed equal in intensity to the first. Introspective data were again taken immediately after each judgment. With a little practice the experimenter found that he could thus produce two tones that appeared "subjectively" equal or that appeared perceptibly louder or softer. For the purpose of our experiment it did not matter whether the standard tones were made absolutely equal. It is safe to assert, however, that the standard tones varied but little in quality and in intensity.

Throughout these experiments standardized instructions were used. Any judgment which was vitiated by distraction or lack of preparation was omitted and the experiment repeated. The data presented below are random selections.

Introspective Data on Processes of Judging

1. *Lifted Weights*

Heavier: "As I was about to lift the first weight I anticipated it to be heavier than it was; this anticipation consisted of visual imagery of my hand, visual imagery of a round tactual-yellow weight inside of which was localized an area of fairly deep black. Then, as I lifted the weight, I was not conscious of kinaesthetic sensations as such nor of any changes in kinaesthetic imagery as such; rather, the muscular effort of lifting the weight resulted in a sudden disappearance of the visualized black from my persisting visual imagery; my hand, which was visualized in white, suddenly became lighter and the tactual-yellow of the visualized weight also became lighter. For an instant I was aware, retrospectively, that the kinaesthetic-black had been present one moment and had disappeared the next, i. e., I saw it present in the imagery and then noted that it wasn't present. All of this constituted the beginning stage of a consciousness that the meaning, 'heft' was absent; had this consciousness developed farther I expect that my experiences would have meant that the weight was light.

"Next, as I was lowering the weight and as my attention was being claimed focally by arm-preparation for the lifting of the second weight, there developed a rather indistinct consciousness of the absolute lightness of the first box. This consisted of a dimly visualized hand and weight localized slightly to the right and upward from the actual position of my hand; here again lightness of the tactual-yellow within the visualized hand represented the light weight of the object. My awareness of preparing to lift the second object consisted of a visualized arm and hand colored almost a black from visualized kinaesthesis; here I was not conscious of kinaesthetic sensations as such; my kinaesthetic consciousness was the black of the visualized hand and arm. I did not anticipate the next weight to be either light or heavy.

"Then I perceived the second weight in the following manner: I visualized my hand, then my forearm in fairly definite outline, then my hand in the act of grasping the weight; the weight was visualized in the usual tactual-

yellow. All of this occupied the focus of attention while my hand was being clasped upon the weight. Just as I began to lift and muscular effort was applied, my consciousness of the weight developed very suddenly in a rapid focussing of attention upon changes in the visual imagery just described; the visual imagery of my hand and arm suddenly turned darker; the weight turned a sooty grey throughout. For a moment these experiences claimed attention to the exclusion of all else. Then I found myself visualizing the first weight off to the right, and here attention was momentarily centered upon its clear whiteness (in comparison to the heavier weight); then attention returned suddenly to my hand with emphasis upon the blackness of the imagery; this blackness meant strain. I found next that my attention was leaving the task; for the judgment was completed in terms of this sudden fixation upon the kinaesthetic-black of strains in my fingers and arm. (I did not visualize the second weight toward the latter part of the judgment; my consciousness of the weight at the time consisted of the kinaesthetic-black just described.) Following the relaxation and slumping of attention I constructed visual imagery of the weight which now took on this same kinaesthetic-black."

Lighter: "I perceived the first weight in terms of a tactual-yellow, round form visualized in my hand with some kinaesthetic-black localized in my wrist and fingers. There at once developed within the visualized weight a small amount of this same black surrounded by the tactual-yellow; this latter experience constituted a beginning conciousness of the 'heft' of the weight. The first of these processes to appear was the visualized hand; secondly appeared the tactual-yellow whose shape and size developed simultaneously and constituted my actual perception; the kinaesthetic-black entered the visualized weight at once with arm-movement of lifting the weight. As arm-movement continued I became conscious of it in terms of a spreading area of this same black along the back of the hand and forearm.

"No change in these processes occurred until I placed the weight back upon the table, whereupon this visual imagery at once became 'static,' i. e., my consciousness now became purely imaginal. There vanished the parent processes which constitute indescribable concomitants of the tactual-yellow and the kinaesthetic-black and by means of which I am evidently able to report the tactual and kinaesthetic meanings of these experiences. Movement, characteristic of the visual black, ceased.

"I then perceived the second weight but as this perception developed the tactual-yellow, localized and shaped as before, was light; a wave of yellowish brightness suddenly spread along the forearm making the hand and forearm appear brighter (interpreted as brighter); attention suddenly shifted to the former, static, visual imagery just described, which I found appearing in the margin of my visual field slightly to the right and above my hand; here attention was centered upon the blackness of the imagery. Again attention shifted to the whiteness of my hand, and I found attention slumping with a tendency to project this whiteness into persisting visual imagery of the weight."

2. *Intervals of Time*

Equal: "In the foreperiod a conscious effort was made to clear the visual field of synaesthetic imagery of all kinds. This was attempted by making rather slow, shifting, eye-movements.

"The first tap appeared as a small brown puff of synaesthetic imagery about an inch and a half in diameter. This image appeared in the right of the visual field, in space, towards the experimenter and at the proper

distance. There was no visual imagery of the experimenter or hammer. As soon as the tap was perceived there began a movement of visual attention across the visual field toward the left. This continued for about eighteen inches at the projected distance. Then the second tap appeared, and immediately after it was perceived, the shift of visual regard was very rapidly retraced to the place where the first image of a tap had appeared. At this point there was a conscious effort to keep the eye-movement static so as not to be out of place when the first tap of the second interval might appear. (It is necessary, in a judgment, to have both intervals begin at the same point in the visual field.) At the appearance of the first tap of the second interval, eye-movement to the left was repeated at the same rate of speed about a foot a second at this projected distance. When the focus of attention had reached the same distance to the left as it had in the first interval, the second tap of the second interval appeared and coincided with a fragmentary image of the second tap of the first interal. Immediately, I was interpretively aware that the two intervals had been the same in duration."

Shorter: "The foreperiod was occupied in clearing the visual field of synaesthetic imagery which might interfere with the judging process.

"The first tap appeared in the right of the visual field surrounded by a very clear neutral gray. The image was a dark brown and as soon as it appeared, eye-movement began towards the left in which direction it continued until the second tap appeared. Then immediately there was a rapid reversal of eye-movement back to the memory image of the first tap. Here, by conscious effort, the focus of visual attention was held until the first tap of the second interval appeared, coinciding in space with, and obliterating the memory image of the first tap of the first interval. Immediately eye-movement again extended to the left, continuing at the same rate of speed as before, but suddenly it was checked by the abrupt appearance of the second tap, which appeared at such a close distance to the starting point that both images were in visual focus, appearing at about three inches distance from each other. To fulfil the *Aufgabe*, rapid eye-movement to the left continued to the place where there appeared a remnant of the memory image of the second tap of the first interval. This confirmatory movement, with the perception of the left memory image, completed the judgment of shorter."

Longer: "The foreperiod was occupied with an effort to remove all imagery from the visual field. This was done by making revolving eye-movements in an effort to avoid having imagery.

"The first tap appeared in the right portion of a visual field of neutral gray. The image appeared abruptly as a synaesthetic dark brown puff of color about an inch and a half in diameter. At once there took place the usual eye-movement to the left which abandoned the image of the first tap and extended beyond the fringe of vision about five inches away. This eye-movement continued through the neutral gray field of vision until the second tap appeared. (The appearance of all taps are the same, with the exception of differences in position.) After the focus of vision had returned to the memory image of the first tap, it was held there by conscious effort (muscular tension of the eye, represented in a flickering appearance such as the appearance of a light from a flash-light held in a shaky hand). Fluctuations caused a sort of visual blur around the memory image for a distance of perhaps an inch. With the appearance of the first tap of the second interval the usual eye-movement to the left began and steadily continued up to and past the memory image of the second tap of the first interval. About six inches beyond there then appeared the second tap of

the second interval. Immediately there was a confirmatory rapid retracing of eye-movement back past the second tap of the first interval which persisted in a memory image at its proper place; and as soon as the starting place had been reached the judgment was complete. These confirmatory eye-movements are habitual and unnecessary to the process of actual judging. The judgment is complete upon the appearance of the second tap of the second interval but the confirmatory eye-movement which scans the entire process seems to definitize the whole process.

"(There is an introspective difference between the sensed tap and the memory image of the tap. The sensed tap contains an auditory 'plus,' while the memory image does not. The memory image is desaturated, less tridimensional in appearance, and is very static and flat.)

"In none of these experiences did the interval of time cause eye-movement to reach its limit. When this is the case there must take place a very rapid retracing toward the source of the interval or, in other words, to the place of origin of the movement. When intervals are longer than one span of eye-movement permits, accuracy of judgment is diminished. When a point is reached at which several spans are necessary, no adequate idea can be gained as to the length of the interval. It then becomes necessary consciously to count the number of eye-movement–spans and to make the judgment in terms of figures. Two and a half or three spans are about all that can be retained as a visual process without relying upon verbal counting to prevent a visual confusion of the different lappings. The different spans appear visually as a form and can be compared roughly with a piece of rope folded back and forth in a compact, snake-like 'S.' Three spans furnish six different visual lines which must be imaged clearly and when more appear they superimpose upon each other, obliterating the 'S.' This makes it necessary to count verbally those that are last to appear in order to conserve them in a verbal, synaesthetic process. Then the single verbal image stands out until the next span is complete.

"The process of judging intervals of time, then, consists wholly of synaesthetic kinaesthesis. The perception of time is made possible by movement of the eyes. Without such movements it would be impossible to differentiate between short intervals and long intervals. This eye-movement is as necessary in the process of perceiving time as is the hand on a clock in recording time. Both are movements and furnish differences in position.

"(There is no definite standard rate of speed at which this eye-movement takes place. In some cases it takes place more rapidly than in others, but when paired intervals are being observed the rate is always subjectively the same for each member. That is, the speed of eye-movement never differs in the second interval from that of the first; but when attending to the rapid ticking of a watch and the slower ticking of a clock, eye-movement must be much more rapid in the former than in the latter, otherwise the visualized tickings would superimpose upon each other, causing a visual blur.)"

3. *Intensity of Sound*

Louder: "In the foreperiod there was an unconscious movement of attention about the visual field for the purpose (which is habitual) of avoiding any distracting imagery.

"The stimulus was perceived in the center of the visual field of neutral gray, and this perception consisted of a synaesthetic visual image appearing as a cone of white about four inches in height, pointed end down. Within the image itself there was a movement upwards from the point of the cone, which gave a sort of dancing, wiggling appearance to the broad upper side

of the cone. As soon as the sound ceased, the image became static in the form of a memory image and there was a movement of the eyes across the visual field toward the left. This movement covered six inches in the projected distance, and meant anticipation of the next stimulus. The second sound appeared where it was anticipated and differed from the former only in its size and in its internal movement. The image of the second sound was about an inch taller and proportionally more slender than the first, while there was more rapid and more exaggerated movement within it. For an instant the second was fixated; then by a slight eye-movement to the right the memory image of the first was brought into focus along with the second. Almost immediately with the appearance of the memory image, it lost its static character and again assumed some of its old internal movements. For an instant these two were viewed side by side at a distance of about six inches from each other, and the second was seen to be taller, more active, and a shade brighter in color. The latter approached the whiteness of white light. The first image was just a shade duller in brightness. It was a recognition of these three differences, visually, that determined the judgment, louder. These recognitions were after-interpretations; and at the time consisted of focussed attention upon the qualities just mentioned."

Equal: "Foreperiod occupied in the process of inhibiting extraneous imagery.

"In the center of the visual field appeared the cone-shaped synaesthetic image of the Quincke whistle. It was a bright white and after it had been attended to and before the sound ceased, eye-movement developed toward the left in anticipation of the second sound. The second sound then appeared; memory image of the first sound was then revived alongside of the second in the focus of attention. At once no difference was visible in the size, shape, movement, or degree of brightness of the two. Sameness in appearance was an interpretation. I was not at the time conscious of similarity, as such. I merely fixed attention first toward one and then toward the other, whereupon I found attention slumping, and I reported, verbally, that the sounds were of equal intensity."

Weaker: "The first sound appeared in the neutral gray visual field as a synaesthetically bright cone with the apex pointing downwards. While the sound persisted, the image was in motion internally and active with the auditory 'plus' present. Following my eye-movement to the left, the second stimulus appeared. It was small, inactive and dull in appearance, and was at once visualized beside the first image. The latter again resumed some of its former movement. Both images remained momentarily in the focal point of vision. I found my attention centering upon the second, to the left, with emphasis upon smallness, inactivity, and dullness. This was all. Attention then slumped."

Summary of Introspections on Processes of Judging

1. *Lifted Weights*

A weight is invariably perceived, first, in terms of synaesthetic, tactual, and kinaesthetic processes, accompanied by fragmentary synaesthetic visual imagery. The synaesthetic tactual processes appear upon a white, visualized hand or upon the weight itself, visualized in

yellow. Where the "parent-process" is present, the tactual-yellow of the sensation has a higher degree of saturation than the tactual-yellow of a memory image of a like sensation. This tactual-yellow varies also in degree of brightness from a very light to a dark yellow, in proportion to the intensity of the tactual sensation and the amount of attending kinaesthesis. These latter variations occur also in memory images of the sensations. During the process of perceiving the weights this tactual-yellow is localized upon *A*'s hand, or anywhere in the projected visual field.

Kinaesthetic processes involved in the initial perception of a weight consist of kinaesthetic-synaesthetic sensations and imagery. A kinaesthetic experience appears as a concrete visual image of *A*'s arm and hand, localized upon and identified with the musculature employed in the process. This synaesthetic sensation consists of black wiggling areas, which vary with the degree of muscular excitation. The greater the intensity of the muscular strain, the more intense the blackness and the more rapid and vivid the internal motion. Throughout the duration of a kinaesthetic sensation the "parent-process" is present as a "plus" and can be attended to only through the medium of the visual wigglings in the synaesthetic sensation.

Once the weights are thus perceived the content of consciousness becomes entirely imaginal. *A*'s awareness immediately takes the form of clear-cut memory imagery of the weight, dominated by kinaesthetic-black. This constitutes an imaginal and synaesthetic "set" which is carried over until the second weight is perceived.

Memory images of the weights are derived from these synaesthetic sensations and are identical with the sensation only in extent and brightness. The memory image lacks the internal movement of the synaesthetic sensation. This makes it appear static and flat. Unlike the sensation, the memory image may appear localized upon a visualized hand or arm anywhere in the visual field. Also, the memory image may appear projected into the weight itself, thus appearing as a static black in the interior of a synaesthetic, visualized, tactual-yellow weight. This occurs when the process of perception has become mechanized.

The processes of perceiving both weights are similar and consist of appropriate kinaesthetic and tactual synaesthesias appearing upon the visualized arm, hand, and weight. During the process of perceiving the second weight the synaesthetic memory image of the first weight is not present to consciousness, but in response to the *Aufgabe* to judge, the memory image of the first weight is "revived," whereupon the judgment follows in attentional emphasis upon certain visual qualities.

It is brightness which is thus emphasized, principally, in comparing

lifted weights. In the process of comparing there occur one or more fluctuations of attention from the perceived second weight to the memory image of the first weight. In each fluctuation the difference in brightness is compared, i. e., the second weight always appears darker, lighter, or equal in degrees of brightness with respect to the memory image of the first weight. The meaning of this relation begins to develop as soon as there is any perceptual difference in the two sets. Likewise, when the first weight has been perceived, the second weight may be anticipated as heavier, lighter, or equal, but in the process of anticipating, the memory image is localized upon the hand or projected into the weight. This process has the appearance of being less static and more real than a pure memory image.

The act of judging a weight as heavier consists of the perception of the first weight and its transfer into memory imagery while the second weight is being perceived. Immediately there is then a process of comparing the two sets of imagery. This consists of visual movement from the second "set" to the first "set." During this process the differing degree of brightness stands out in terms of attentional emphasis. Thus begins the development of the meaning that the second image is the darker.

The process of judging a weight as lighter consists in the perception of the first weight in synaesthetic visual terms and the immediate transfer of this process to memory imagery while the second weight is being perceived. Immediately there occurs a process of visual comparison by shifting the focus of attention from the second set of imagery to the first set, in which process the degree of brightness of the second set is compared to the degree of brightness of the first. When the brighter quality of the second set is perceived, there occurs a beginning of a developing meaning which, when attention is emphasizing the lighter quality of the second set, will develop into the explicit meaning "lighter" by translating this emphasis into verbal terms.

The process of judging a weight "equal" consists of the perception of the first weight, which rapidly becomes transferred into memory imagery during the process of perceiving the second weight. When making the judgment "equal" there are more movements of visual verification than in the judgments "heavier" and "lighter." There occurs a more detailed visualization. Each set of imagery, in its turn, stands out clearer in attention, and the meaning, equality, develops in a distributed attentional emphasis upon both objects. The explicit state of this meaning occurs when it is possible to respond to this attentional spread, in verbal terms, but this process of elaboration of meaning is not necessary for a termination of the judgment, so mechanized are *A*'s visual responses.

2. *Intervals of Time*

The process of perceiving the first interval of time consists of a black synaesthetic "sensation" which appears in the center of *A*'s visual field and begins to move at once outward and toward the left. This moving synaesthetic process rapidly fades until it becomes a very faint synaesthetic gray line, or track, only slightly darker than the neutral gray through which it travels. It continues to the left until the second tap is perceived synaesthetically, whereupon a similar movement takes place differing from the first only in position. Both perceptions involve a "parent-process," and auditory "plus," and both movements contain a kinaesthetic "plus." The first tap of the second interval is then perceived in the same position as the first tap of the original interval, a position which was in visual consciousness as a memory image up to the time the first tap of the second interval was perceived. Eye-movement and focus of visual attention then follow along a faint trace of the path traversed during the first interval. The track representing the second interval terminates as did the track of the first interval in the synaesthetic sensing of the second tap. The process of judging longer, shorter, or equal then assumes the form of a visual comparison between the length of the two lines traversed by the fixation point and designated by the relative position of the two images of the two final taps. In the judgment longer *A*'s localization of the second tap of the second interval appears to the left of the memory image of the second tap of the first interval. If this occurs immediately there develops an implicit meaning, longer, within *A*'s visual consciousness. This meaning is an attentional emphasis upon the visualized space between the positions of both second taps as they are represented in consciousness, synaesthetically, the former being a memory image and the latter a tapering-off perception of the final stimulus. The meaning, longer, subsequently becomes explicit when this visual emphasis is translated into verbal terms.

The judgment, shorter, consists of a visual process in which the last synaesthetic sound is localized between the point in the visual field where occurred the first taps of both intervals and the memory image of the second tap of the first interval. When this takes place immediately there develops an implicit meaning, shorter, as described above, which becomes explicit as soon as the situation is responded to by employing some word which conveys that meaning, i. e., adds to the context.

The judgment, equal, is simpler than the judgments longer and shorter. Here, synaesthetic representations of the stimuli coincide with respect to position.

In this series of experiments it so happened that the process of

judging intervals of time was reduced to a minimum of activity. That is, in no instance did eye-movement occupy any considerable extent of *A*'s visual field, and the stimuli which terminated both the first and second intervals were localized closely together. Where long intervals of time are given, the process of judging becomes much more complicated.

An interval, in which the length of time carries eye-movement out into the limits of the visual field, makes it necessary to continue the process of perceiving this passage of time by returning, visually, to the point of origin and by repeating the process until the final tap is heard. A difficulty here involved in this multiple process consists of counting the numbers of repetitions thus executed. The first three or four repetitions of movement usually linger on as visualized paths across the visual field; but more than four result in confusion and it is then necessary to rely upon a mechanical device of counting them as they take place. For example, one interval requiring seven repetitions of eye-movement and another interval requiring nine and a half, changes the process of judging from that of a perception of a time interval to a single problem in addition. This addition is accomplished by means of *A*'s number form.

In judging intervals of time *A* thus relies wholly upon eye-movement. In this connection it is interesting to note that this eye-movement need not be constant in rate from the standard to the comparison interval, but let the rate of movement already set up in perceiving a single interval be altered during its course and the process of comparing that interval with another is rendered impossible.

In judgments in which the two final stimuli are represented within the focus of attention, consciousness of relation need not develop beyond a mere process of perceiving. On the other hand, in judgments in which one end-stimulus is focal and other non-focal, a space must be visualized between the two. This is done by eye-movement from the last stimulus back to a memory image of the tap which terminated the first interval. This process furnishes implicit meaning in terms of position between the two end-taps. Where judgments involve eye-movements across the visual field, beyond the number that can be perceived and retained, visually, implicit meaning of a difference in positions of end-taps is derived by having recourse to *A*'s number form.

3. The Process of Judging Intensities of Sound

The content of the process of judging a sound louder consists, first, of perceiving the initial stimulus in terms of a visual synaesthetic cone with vertex pointing downward. The auditory parent-process is attended to by fixating, visually, internal movements of the wide, upper portion of the cone. Here also, appears the kinaesthesis of

muscular attention. The perception has a given shape, color, and size. Second, this perception gives way to a memory image of the stimulus. This memory image resembles the perceptual process in every respect except in its loss of internal movement. At this juncture *A*'s consciousness of the stimulus may in turn give way to an anticipation of the second stimulus in terms of eye-movement away from the image of the first stimulus, or in terms of superimposing the anticipated image upon the persisting memory image of the first stimulus. In either case there is then an immediate process of comparing in which an implicit judgment is made, for at once, either by momentary eye-movement of verification or by holding both images in the focus of visual attention, the implicit judgment is made in terms of attentional emphasis upon the brightness, shape, and size of the images. When the image to the left attracts attention because of its height and size, the implicit judgment is complete. In the judgment, weaker, the first image, appearing on the right, must be the one to attract attention because of its brightness, height, and size; or according to the *Aufgabe*, the left image must attract attention because of its size and length. The meaning of a difference is an exceedingly attenuated shift of attention from one to the other, with a sudden localization of one rather than the other, according to an implied *Aufgabe*. It is this dynamic, process-aspect of attentional shift and emphasis—a rapid rise in degree of attention to specific qualities already possessing the meaning of brightness, size, height, etc.—that constitutes implicit meaning of a difference, i. e., a relational consciousness. In other words, a small image receding at the same time that a large image becomes focal—with momentary visual spread of attention to both—provides, when synthesized, the meaning of a difference.

There exist typical differences between memory images and sensations. Memory images lack the parent-process, and internal kinaesthetic movements are absent. In the case of a sudden recall of the first stimulus in the form of a memory image immediately after the second stimulus has passed, it is possible to detect faint parent-processes together with internal kinaesthetic movements. This takes place only when the first and second stimuli are of exactly the same pitch. In all other instances of recalled memory images the image appears as a static visual image without a trace of moving kinaesthesis or parent-process.

The greatest difficulty in the process of judging is in reducing implicit meaning to explicit meaning and verbal expression. The implicit process of comparing is immediate and is completed instantly. *A*'s ordinary higher thought processes run no further than the implicit stage when engaged in silent judgments. For example, when *A* perceives a series of several locomotive whistles of different inten-

sity they all are immediately and implicitly compared, and the louder and weaker blasts stand out in their visual proportion with complete implicit meaning as to their relative intensity. But in the case of a self-imposed *Aufgabe* of identifying the weaker blast this process is impossible without making some kinaesthetic response to the weaker image. This kinaesthetic process constitutes a beginning of the implicit meaning which, if continued, would result in naming the blast as the second or third whatever the case might be. In our experiment with the Quincke tube the process became so highly mechanized and the *Aufgabe* so habitual to respond explicitly to one of the three alternatives that the transition between developed and undeveloped meaning could not be detected. All meaning was implicit.

To summarize the importance of synaesthesia in the process of judging, we find that there is no place where synaesthesia does not function. It comprises the content of consciousness in tactual and kinaesthetic experiences, in perception of space, form, time, intensity, and weight, in memory after-images, and in the processes of verification. Finally, it forms the content of meaning by which comparisons are made, the content of which forms the first stages of meaning, later to be translated into verbal terms.

The process of mechanization develops rapidly throughout the first part of a series of experiments on the process of judging. The synaesthetic imagery becomes more schematic, i. e., the unimportant parts of the imagery drop out, while at the same time the imagery which remains becomes detached from the stimulus and floats out into visual space. Visual attention fixates merely those parts of the imagery which are essential in making the judgment. These portions in turn become more fragmentary and abbreviated so that they reach a minimum visual extent, but recognizable, and are capable of constituting complete implicit meaning. The process of mechanization was more striking in judging lifted weights than in either of the other two series of experiments for there was a greater amount of muscular movement required in making the judgment of the weights than in judging the extent of time or intensity of sound. The last stages of mechanization had been reached in the experiments of judging lifted weights when the visual content of kinaesthesis "entered the weight" as a black form within the tactual synaesthesia of the perception. The judgment was made from the extent and intensity of this black, which latter constituted complete implicit meaning of the intensity of the weight. Such processes of mechanization occur constantly in *A*'s everyday life. For example, when he is pitching hay, the multiplicity of synaesthetic images which is at first experienced becomes reduced to a minimum. The black kinaesthesis, which is at first localized upon the arms and down the fork-handle, finally reaches

the stage where the size of the forkful of hay is judged from the amount and intensity of the black kinaesthesis, which has been transferred to the tines of the fork. The kinaesthetic synaesthesis has been projected out to the end of the fork, away from the actual muscles where the parent-kinaesthetic process is localized. The parent-process is not seemingly employed in the process of judging the amount of weight upon the end of the fork.

Consciousness of relation consists of two contents: qualities of brightness towards which consciousness shifts and brightness away from which consciousness shifts. Following this shift there is an interpretation. Failure to analyze this interpretation into its stages has led to the belief that the relational content of consciousness is imageless.

Summary and Comparison of Our Results with Fernberger's

Fernberger's more important findings, relative to our interests, may be summarized as follows:

1. The process of judging, like all other forms of thinking, such as recognizing, choosing, and reasoning, begins either with a conscious *Aufgabe* or an implied *Aufgabe* which may be called a "set" or "predisposition."

2. The judgment proper begins with a perception of the standard object in which there is a characteristic focussing of attention upon a certain quality of experience such as intensity of muscular strain, intensity of tone, the brightness of a grey. There invariably appeared, however, certain associated processes along with this localization, including visualizations of the weight, visual localizations of muscular strain, eye-movement, and the like.

3. In the earlier judgments of each series awareness of the standard object then shifted to imaginal processes with a persisting of motor adjustments which had been made in the original process of perceiving. This combination of imagery and motor adjustment constituted a "set" in terms of which the comparison object was perceived.

4. The final judgment issued (*a*) from a shifting of attention from the intensity of sensations of the comparison stimulus to imagery which had persisted from the giving of the standard stimulus and (*b*) from a change which took place in the motor set. If the motor adjustment was insufficient and therefore further adjustment necessary, the reagent pronounced his judgment as heavier, louder, or longer, as the case might be. If the "set" was oversufficient, the judgment was lighter, softer, or shorter.

5. As the experiment continued, processes of judging passed through various stages of mechanization. Associated imagery was the first to disappear, such as visualization of the weights, and tactual

imagery in the memory consciousness of the standard weight. Little by little attention ceased to emphasize visual or auditory factors, leaving kinaesthesis as the dominant content. In this way, practically all forms of judgment came to be made largely in terms of changes in motor adjustments.

6. The consciousness of relation turned out to be an interpretative consciousness. That is, there was no elemental relational consciousness, or no imageless process of any kind. Consciousness of a similarity or difference was a phenomenon of meaning which accrued to changes in intensity and quality of sensation and image, and which demanded interpretation.

Our results on judgment confirm these of Fernberger's in practically every respect. Since our interest lay not so much in verifying his results as in noting the functioning of synaesthesia, we paid little attention to foreperiods in the process of judging. However, every process of judging, in *A*, began with a task consciousness and the usual preparatory motor adjustments. In the foreperiod, however, anticipation of the material itself and the incipient motor adjustments as well were throughout present to *A*'s consciousness in terms of synaesthetic imagery, mixed with asynaesthetic visual imagery.

The perception of the standard object was, as usual, highly synaesthetic. Kinaesthetic sensation and all its characteristics were present in terms of black areas, varying in darkness, size, location, and movement according to the intensity and character of the stimuli. Auditory experiences were present in their usual synaesthetic forms, likewise tactual and all other non-visual processes. In the earlier judgments *A* found associated processes, along with the focal elements, as did Fernberger's subjects. For example, a weight was visualized, tactual experiences were represented within this visual imagery by the presence of certain colors. While at times *A* localized kinaesthetic experiences in the region of the musculature in question, more frequently this visualized kinaesthesis was projected into the asynaesthetic visual imagery of the stimulus. No consciousness of the arm, as such, would then be present.

The perception of the standard stimulus, however, did not shift to imaginal processes. There was merely, in the main, a persistence of synaesthetic imagery which constituted *A*'s memory consciousness of the stimulus. In the more vigorous judgments there was present the parent-process during the original perception. This dropped out, as evidenced by the characteristic change in synaesthetic imagery from a wealth of internal motion to a relatively static appearance. This was all that characterized the change from percept to memory image, save for the possible disappearance of associated imagery. This persisting synaesthetic process was kinaesthetic, in meaning, for lifted

weights; auditory, in meaning, for sounds; kinaesthetic and visual for intervals of time.

Hence our reagent differed from Fernberger's in an important respect. While his observers reported two outstanding groups of processes, imaginal and sensory-kinaesthetic, *A* reported only imaginal processes. This does not mean that in *A* kinaesthetic adjustments were lacking. They were present just as in Fernberger's subjects but were represented in consciousness by synaesthetic imagery. This fact led to a further difference between the two sets of results, which we mentioned under mechanization.

In *A* the final judgment issued from a change which took place in his synaesthetic imagery. This change was a shifting in brightness, size, form, and position of the imagery in question. Hence, synaesthetic imagery performed two related functions: (*a*) that of a memory consciousness, and (*b*) the "set" in terms of which the comparison stimulus was perceived. The final judgment was always a very rapid and simple process. Insufficiency or over-sufficiency in his imaginal set was corrected by a few simple changes as have just been mentioned.

Indeed, so rapid and syncopated was this final stage in the judgment that the meanings of similarity and difference were implicit in the changes in this synaesthetic imagery. In fact the development of these meanings was so rapid that the reagent's consciousness was dominated by implicit meanings of heavier, lighter, louder, softer, longer, shorter, or equal, as the case might be, rather than by imaginal contents as such, which were to be followed by explicit processes of interpretation. In other words, immediate content and interpretation coincided, so far had this foreshortening process gone. This characteristic of the development of meaning in *A*'s consciousness is evidently due to the fact that such kinaesthetic elements as in asynaesthetic subjects must develop before meaning becomes explicit are already contained in *A*'s synaesthetic imagery in the form of motion and degrees of blackness.

It follows from this that the latter stages of *A*'s judgments did not reveal the same processes of mechanization as did Fernberger's judgments. While Fernberger found that the meanings, lighter, heavier, equal, etc., were fairly elaborate interpretations from sensory and imaginal data, and that, as mechanization went on, these mechanical disappeared with tendencies to interpret, leaving merely a mechanical verbal reaction to the comparison stimulus, *A* found that his consciousness of relation was quite as definite in the end as in the beginning.

Consciousness of relation, then, in *A*'s case, was a meaningful synaesthetic image, throughout, the meaning accruing to such fea-

tures as size, form, shape, brightness, position, and motion, usually several of these factors taken together.

This confirms Fernberger's conclusion that there are no imageless relational meanings, and no relational elements of consciousness. The demanded interpretation, paramount to the development of meaning, was already present in the functioning of *A*'s synaesthetic imagery.

II

It was the primary purpose of our experiments on choosing to determine the degree to which synaesthetic imagery functioned. In order to check our methods and results with those of a similar study performed upon so-called asynaesthetic subjects, we followed Wheeler's investigation of choosing.[3]

It was found necessary to reduce the experiments to their utmost simplicity in order to secure a minimum of synaesthetic imagery, for presentations of alternatives other than by the auditory method produced such a mass of synaesthetic imagery that introspections upon the actual processes of choosing became too complicated and unreliable. The apparatus employed consisted of a Victor phonograph and records. T.D.C. acted as observer throughout the series. The following instructions were presented orally by the experimenter, R.H.W.: "I have here two phonograph records one of which I will play for you. Which will you choose?" Or: "Here are two magazine articles, one of which I will read to you. Which will you choose? The one is on sociology, the other is on embryology." Again: "What will you choose to do this afternoon—study history or go for a walk?" And again: "Which will you take—a pipe or a cigar?"

Typical Introspective Data

Choice between two musical selections: "Land of the Sky-blue Water," sung by Alma Gluck, and "Evening Echoes," instrumental. Auditory presentation.

"I perceived the first alternative, the 'Land of the Sky-blue Water,' in terms of synaesthetic imagery of *E*'s voice together with fragmentary visual-auditory imagery of Gluck's voice. There was a marked tendency to follow these grey, silvery-white conical shaped forms upward and to the right as they tended to float out of my field of vision. At this juncture attention was claimed focally by kinaesthetic grey-black of eye-movements present in the form of small, indefinitely shaped streakings located in visual space extending beyond, above, and below the auditory-colors, and in part by the brightness of

[3]Wheeler, R. H. An experimental investigation of the process of choosing. *Univ. Ore. Publ.*, 1920, 1, (no. 2). Pp. 59.

the auditory-visual imagery. These fixations of attention constituted the beginning stage of a desire to hear the selection.

"Then in terms of eye-movement to the left (of which I was conscious in terms of kinaesthetic dark-grey streakings preceding my line of regard) I anticipated as the next alternative was about to appear. (I always employ a 'choice form'; this consists of projection of one set of imagery to the right and about six or eight feet away from me, and the other in the same relative position at the left in my visual field.)

"I perceived the second alternative 'Evening Echoes,' in terms of synaesthetic imagery of the words consisting of dark blots or amorphous clouds, greyish in type, assuming a bar-shape on their right; this synaesthetic imagery was concerned with the sounds of the words; the meaning, 'Evening Echoes,' did not develop as such, for attention shifted at once to synaesthetic imagery of the selection itself. This consisted of brilliant streaks and bands of different degrees of brightness tinged with silver and yellow for the harp notes; these slid up and down in my visual field, constituting my consciousness of runs on the harp. Other auditory-visual imagery was vague and consisted only of diffuse colorations projected upon a blue-tinged background which latter meant to me that these images were those of a flute. The blue was a poor 'ocean blue' with somewhat less green than the ordinary color of an ocean.

"Then there developed to the left of this latter imagery a mass of black with indefinite shape and outline; this was not recognized at first; it had no meaning. Suddenly, however, I was aware of auditory-visual imagery of the experimenter saying: 'We will play one of them clear through' in the usual silvery-grey of his voice; whereupon this black mass just mentioned began to move and wiggle; it thus took on definite kinaesthetic traits, and was at once interpreted as a fragmentary memory consciousness of the strain which I experienced when the selection had been played to me a short time before and had been stopped before it was finished. I then noted a tendency for this kinaesthetic consciousness to become more intense, vivid, and real as it was localized in my chest and shoulders. This localized kinaesthetic-visual consciousness (for the strain was a visual black localized on my body) developed into a tendency to lean toward the left—the region where my auditory-visual imagery of the selection was persisting. This latter experience was at once interpreted as a desire to go ahead and finish the selection. This interpretation consisted of a tendency for the visualized kinaesthesis to linger in my chest and shoulders together with a visualization of the outline of my body in these regions. The remainder of the interpretation comes only in telling the experience.

"I then momentarily shifted to the right in the direction of the

place just occupied by auditory-visual imagery of the other selection; attention suddenly returned to my persisting bodily attitude and to the persisting auditory-visual imagery of the 'Evening Echoes.' The choice took place upon the fixation of visual attention originally on the auditory imagery of the Echo-song, upon the auditory-visual imagery of *E*'s voice and upon the motor attitude. It was an active choice; the active feature of the choosing consisted of the rapid shift of attention upon the Echo-imagery but more especially of the bodily, localized visual-kinaesthesis."

Summary of Introspective Data

Invariably our subject perceives the alternatives in terms of highly schematized visual images which comprise a mechanized "choosing-form" with complete implicit meaning resident in the color, form, position, and behavior of the synaesthetic imagery. The schematized choosing-form develops with, and is a part of, the process of perceiving the alternatives. It functions by carrying the implicit meaning of the situation. The implicit meaning of the *Aufgabe* is present in the general shape of the choosing-form and still more conscious in the switching of visual attention from one visual alternative to the other.

A's "choosing-form" is one of those visual phenomena akin to visual number forms which develops from the necessity of reducing situations to the minimum amount of imagery. In general the choosing-form appears in a tridimensional visual field with the points extending toward and down to the observer. The two alternatives invariably appear upon the points, and back of the alternatives there appears synaesthetic imagery important for the meaning of the situation. This can be referred to instantly by a slight shift of visual attention up the bars, or as more often occurs, the bars appear dimly in the margin of visual attention while the points are being attended to. For example, in one introspection the visual image of an open magazine, the lower part of two pages colored with the verbal synaesthesia of "magazine" and a further extension of the bidimensional form into the black of "articles," functioned as the implicit meaning of the entire situation—that the magazine was read aloud, and that the black "article" was an article which would be read when a certain point on the bidimensional form was fixated or, in other words, chosen.

By the use of his choosing-form, *A* reduces the act of choosing to a purely visual process, which consists of fixating one alternative after another, in the case of a conflict. Each shift of visual attention brings the fixated alternative into a focus and shifts the other into the far margin of attention, or out entirely. There is a slight amount of

visual kinaesthesis appearing in terms of visual synaesthesia accompanying the shifting processes. The final choice is made when the alternative appears to move boldly into the front and center of visual attention, with some additional degrees of clearness and brightness if pleasantness is involved in the choice. The additional degree of brightness possesses the implicit meaning of pleasantness and appears in place of the stronger organic imagery which, if it appeared, would tend to destroy the choosing-imagery. Likewise the movement of the alternative into the front and center of visual attention represents a very mild form of eye-kinaesthesis which, if it appeared in more abundance, would destroy the imagery of the choosing-form. The small amount of kinaesthesis which does appear is sufficient to carry the choice.

The lack of conscious kinaesthesis, as such, in the process of choosing gives to synaesthetic imagery an attribute of objectiveness which separates completely the imagery from the observer as a conscious self. In other words, when no conscious kinaesthesis appears, nothing exists but the synaesthetic imagery. The subject is utterly oblivious of self. In cases of difficult choices, kinaesthesis develops in a sufficient degree of intensity to attract visual attention. Then the kinaesthesis is immediately referred to the body of the subject and comprises a consciousness of self. A similar process takes place when *A* responds or tends to respond explicitly to the implicit meaning of the imagery. Consciousness of self is not exclusively the visual consciousness of the synaesthetized kinaesthesis, nor is it the visual imagery of different parts of the body from which the synaesthesis has its origin. Rather it is a synthesis of these factors, and of unquestionable importance is that indefinite "something" which comprises the parent-kinaesthetic process, and which can best be described as that meaning of unlocalized or detached, abstract muscular strain, so difficult for asynaesthetic observers to detect and impossible for *A* to cognize in any direct manner.

Summary and Comparison of Our Results with Wheeler's

We are able to confirm Wheeler's conclusion that no imageless processes are present in the acts of choosing studied. Our reagent employed synaesthetic visual imagery throughout to the exclusion of other sense modalities. The only possible exception is the unanalyzable, non-visualized kinaesthetic, parent-process which is interpreted in certain settings as the consciousness of self.

We are able to confirm the conclusion that no particular mental elements are essential other than kinaesthesis, or its synaesthetic substitute. It was due to the visual kinaesthesis that the choice was made for it functioned in the shifting and fixating of attention and deter-

mined the position and clearness of the alternative. The explicit responses always appeared in terms of a more exaggerated motor synaesthesia.

Wheeler found in his subjects that tentative choices and motives, and that final decisions and motives were identical. We are able to confirm these conclusions in that our subject employed the same kinaesthesis in his tentative choices as he did in the final decision. The shifting of a visual attention from one alternative to the other comprised the kinaesthesis involved.

Wheeler's subjects were unable to choose in the absence of kinaesthesis. Although *A*'s kinaesthetic processes are visual in content, they functioned in the process of making the choice. They appeared in the shift of visual attention and in the movement of the alternative which was chosen.

The presence of the *Aufgabe* was found to be in the mental "set" of Wheeler's subjects. In *A*'s process of choosing the *Aufgabe* also was contained in the mental "set" which was the visually developed choosing-form. This form involved the implicit meaning of the *Aufgabe* to choose.

There exist several differences between our subject's processes and those of Wheeler's subjects. It is impossible for *A* to continue his process of choosing in the presence of conscious kinaesthesis, for the visual synaesthetic imagery of the motor responses obliterates and floods over his schematized imagery of the choosing-form. It is necessary that kinaesthetic imagery always be reduced to a minimum. The choice is always implicitly made after which there may be a flood of explicit kinaesthesis spreading up through the visual field, but within this mass of kinaesthesis there exists in terms of visual synaesthesia, a verbal image stating the decision.

Wheeler found that the vigor and genuineness of a choice depended upon the intensity and complexity of a motor response. We have confirmed this result also, for in *A* the vigor of a choice accrues to the following factors:

1. The appearance of extended areas of visualized kinaesthesis localized, visually, in the region of the shoulder and chest muscles. The blackness of this visual imagery and its internal motion are proportional to the intensity of the motor reaction.

2. Attentional emphasis upon this whirling, seething blackness, which possesses an attribute of subjectivity, or better a bodily reference, and an implicitly interpreted meaning of self.

3. Angularity of the choosing form, with a visualized element of kinaesthesis projected onto it, together with the kinaesthetic parent-process. The latter is as usual so obscure that it demands focussing of attention upon it in an effort to make it definite but

always so elusive as to evade attention, leaving, as a datum of consciousness, only the representative blackness.

Wheeler interpreted the process of choosing to be a motor response which at the outset was general in nature and which, as the act of choosing proceeded, became definitized in two directions; namely, toward each of the two alternatives. A conflict consisted of the inhibition of one of these definitized responses by the other. The choice matured when one of these latter responses became reinforced by additional stimulation such as came from subsidiary *Aufgaben*, memory imagery of experiences associated with the alternative in question, and by the products of judging. *A*'s procedure was functionally similar. While he did not make the complex motor reactions that Wheeler found in choosing, his visual attention, together with the shiftings of visualized kinaesthesis from one side of the choosing-form to the other, followed the same general course as did explicit adjustments in Wheeler's subjects. The *Aufgabe* contained the same type of preparation, in which motor adjustments were confined to fixations of the choosing form and eye-movements over it. The definitization of this general, foreperiod adjustment, took place in two directions, the one toward one end of the choosing form, the other toward the other end. Reinforcement of one of these fixation or movement tendencies came about in the same manner as in Wheeler's observers. A memory consciousness or a judgment process, or some associated image, set off a sudden fixation of one side of the form. The kinaesthetic features of this fixation of one side of the form were visualized sensations of eye-movement and additional kinaesthesis, not localized upon the body but projected onto the form in terms of a darkening process.

Such attitudes of acceptance as were found to characterize Wheeler's processes of choosing, consisted of two outstanding sets of experiences in *A*. If the choice was fairly easy and rapid, this acceptance consisted of a sudden dropping of the choosing-form, traceable to a nod of the head. In the more difficult choices, acceptance became a visualized bodily reaction, together with a synaesthetic static experience—a change in the apparent spacial relations of a choosing-form and the reactor, with a lack of compensatory eye-movements. (Comparable to the illusion obtained when one is looking at a star, moves his head, and the star seems to move rather than the head.)

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LA SYNESTHÉSIE DANS LE JUGEMENT ET LE CHOIX
(Résumé)

Cette étude continue une série d'investigations de la synéthésie chez un sujet aveugle. La méthode a suivi celle de Fernberger sur le jugement com-

paratif et celle de Wheeler sur l'acte de choisir. Les témoignages introspectifs ont indiqué qu'il n'y avait aucun trait du jugement non caractérisé par un processus synesthétique. La perception des instructions, la perception des stimuli et des mouvements des bras, etc., ont eu lieu en termes de clarté et de couleur. Il n'y avait pas d'expériences relatives incapables d'analyser et il n'y avait aucun processus sans images.

Les résultats de Wheeler sur l'acte de choisir ont été confirmés. Il était impossible, d'ailleurs, pour ce sujet aveugle de faire son choix en termes visuels, auditifs, kinesthétiques, ou autres termes non visuels. Les images visuelles et synesthéthiques des réponses motrices ont effacé sa forme de choisir, laquelle semblait être un facteur essentiel dans sa façon d'agir.

La vigueur du choix a été montrée par des espaces noirs et bouillonants, localisés sur la figure, le cou, les épaules, et la poitrine. La noirceur de ces images visuelles avec ces motions intérieures a été apparemment proportionnée à l'intensité des réactions motrices du sujet.

On a constaté d'autres évidences d'un "processus-parent" avec une expérience synesthétique quelconque. Ce "processus-parent" n'avait aucune caractéristique descriptible sauf celle d'un "plus." Il était toujours obscur et trompeur. Le sujet l'a décrit comme étant toujours un pas derrière l'attention. Cependant, il y avait quelque évidence que ce "plus" était constitué, pour la plupart, du mouvement vu dans l'image visuelle.

WHEELER ET CUTSFORTH

SYNOPSIE BEIM URTEILEN UND WÄHLEN

(Referat)

Diese Arbeit ist die Fortsetzung einer Reihe von Untersuchungen über Synopsie bei einer blinden Versuchsperson. Man befolgte Fernbergers Methode über das vergleichende Urteil, und Wheelers, über den Akt des Wählens. Introspektive Angaben deuteten an, dass es bei dieser Vp. in dem Akt des Wählens keinen Zug gab, der nicht die Merkmale des Synopsieschen Vorganges trug. Wahrnehmung der Anweisungen, Wahrnehmung der Reize und Armbewegungen, usw. äusserten sich als Begriffe von Helligkeit oder Farbe. Es gab keine unanalysierbaren, bezüglishen oder verwandten Erfahrungen, und keine Vorgänge irgendwelcher Art ohne bildliche Vorstellungen.

Wheelers Ergebnisse über das Wählen, fand man bestätigt. Es war dieser Vp., jedoch, umöglich in Gesichts—oder Gehörvorstellungen, in kinaesthetischen oder andern nicht-visualen Vorstellungen, ihre Wahl zu treffen. Synaesthetische Gesichtsvorstellungen der motorischen Reaktionen zerstörten die Wahlform, welche ein wesentlicher Faktor in dem Vorgang des Wählens zu sein schien. Die Stärke des Wahlimpulses zeigte sich in schwarzen, wogenden Massen, die Gesicht, Hals, Schultern, und Brust umflutheten. Die Schwärze dieser Gesichtsvorstellung und deren innere Bewegung, schienen zu der Heftigkeit der motorischen Reaktionen der Versuchsperson im Verhältnis zu stehen.

Weitere Beweise für einen sogenannten "parent-process" fand man in Verbindung mit irgendeiner synaesthetischen Erfahrung. Dieser "parent-process" hatte keine anderen, nennbaren Merkmale als ein "plus." Er war immer dunkel und flüchtig. Die Vp. beschrieb ihn als bliebe er immer einen Schritt hinter der Aufmerksamkeit zurück. Gewisse Beweise, jedoch, deuteten an, dass dieses "plus" hauptsächlich in der Bewegung bestand, die innerhalb der Gesichtsvorstellung wahrgenommen wurde.

WHEELER UND CUTSFORTH

СИНЭСТЕЗИЯ ПРИ СУЖДЕНИИ И ВЫБОРЕ

(Реферат).

Этот эксперимент является продолжением серии исследований синэстезии у слепого испытуемого. Для выявления сравнительного суждения был употреблен метод Fernberger'a а для акта выбора — метод Wheeler'a. Интроспективные отчеты указали, что не было ни одной характеристики в суждении, которая не была бы охарактеризована синэстетическими процессами. Восприятие инструкций, восприятие стимулов и движений рук и т. д. происходили посредством светлоты и цвета. Не было в сознании никаких элементов отношений, не поддающихся анализу, а также не было никаких без-'образных процессов. Результаты Wheeler'a относительно выбора нашли потверждение. Однако слепой испытуемый не мог произвести выбора посредством зрительных, слуховых, кинэстетических и других не-зрительных элементов. Зрительные синэстетические представления моторных реакций стушевали его способ выбора. Интенсивность выбора была засвидетельствована черными кипящими площадями, локазированными около лица, шеи, плеч и груди. Чернота зрительного представления вместе с его внутренними движением была, повидимому, пропорциональна интенсивности моторных реакций испытуемого. Было обнаружено доказательство «родительского процесса» («parent-process») в связи с любым синэстетическим переживанием. Кроме «плюса», «родительский процесс» не имел никаких других характерных черт, поддающихся описанию. «Плюс» всегда был неясен и ускользающ. Испытуемый заявлял, что этот «плюс» всегда отставал на шаг от внимания. Однако было налицо некоторое доказательство, что «плюс» главным образом состоял из движений в пределах зрительного представления.

УИЛЛЕР И КОТСФОРТ
(Wheeler and Cutsforth)

AN EXPERIMENTAL TEST OF THE SERIAL CHARACTER OF A CASE OF PURSUIT LEARNING*

From the Psychological Laboratories of Ohio State University

SAMUEL RENSHAW

I. INTRODUCTORY SUMMARY

Three subjects were trained to operate a special type of pursuitmeter, to be described later in this paper. The movement to be learned consisted in *pursuing* a moving electrode through a complex geometrical pattern in the horizontal plane. Each break in contact with the moving electrode, or "error," resulted in stopping the instrument. These breaks were magnetically recorded on a paper tape. Motion was resumed on re-making contact. Practices were held three times weekly and were continued until no significant gains were observed on two successive sittings. Thereupon, without warning to the subjects, the pattern of transit of the moving electrode was reversed or rotated through 180°. To anticipate our conclusions, no significant difference in the performance of any subject was observed—no difficulty in operating the instrument in the reversed order of the pattern with respect to the learned or forward order. The original order was then restored at the next sitting and again reversed on the following one. Still there was no observed impairment of performance.

If the pursuit movement is a *serial* habit, we should expect a reversal of pattern to be followed by a significant and unmistakable increase in the number of breaks or errors per unit of time or per cycle of the instrument. This would not necessarily be true in case reversal of pattern failed to constitute a crucial test of the serial nature of the habit.

The present paper (1) presents the results and some critical aspects of the problem under investigation; (2) concludes that the evidence in the present case tells against the assumption that this particular form of learning is serial in character; (3) points out a neglected phase in the systematic description of habits; and (4) presents a *successive discrimination* hypothesis as an alternative mode of selection in the formation of habits of this type.

II. PROBLEM, METHOD, AND SOME THEORETICAL CONSIDERATIONS

Most acts which involve a succession of movements leading to consummation are generally described in the psychological literature as

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